Evaluate Combined Sobel-Canny Edge Detector for Image Procssing

Dr. Luma Salal Hasan
Computer Science Deptt., Mathematics & Computer Science College, Al-Qadisyah University
Dewanyah, Iraq
e-mail: lumasalal69@yahoo.com

***Abstract*— Edge detection is one of the fundamental operation of the computer vision to locate the sharp intensity changes to find the edges in an image. The selection of detector depending on the environment , especially in noisy background.In this paper, presents a brief theory for the sobel kernel and canny edge detector.Then propose an algorithm which combined two detectors, the sobel detector which is widely used in digital image processing and canny edge detector that is another classical techniques. The design consists of three stages.Firstly added salt & pepper noisy to the original free noisy image file then compute the sobel detector for the file ,then apply canny detector on the results of the second stage to filter the pixel that signed out as an edge in the sobel detection by using Gaussian filter. Test the algorithm by using various file which contains salt & pepper noise with free noisy image with different values of sigma to evaluate and specify the performance, weakness.**

***Index Terms*— Sobel detector, canny edge detection, combined sobel-canny**

I. Introduction

Edge detection is a type of image segmentation techniques which determine the precesence of an edge in image to reduce the amount of data to be processed[3].Generally, an edge is defined as the boundaries pixels that connect two region with different amplitude . there are several types of edge detector operator which depending on the edge orientation, noise environment and edge structure. The operator can be optimized for searching vertical, horizontal or diagonal edge [4].

Edge detection techniques is very sensitive in noisy environment because the high ratio of amplitude.Marr & H.dreth [7] introduced the theory of edge detection and described a method for determining the edge by using zero crossing of the laplacian of Gaussian of an image.Clark[2] & Ulupinar[8] founded a method to filter out false edge obtained by the laplacian of Gaussian operator.Bergholm[1] introduced the concept of edge focusing and tracked edges from coarse to fine the mask weak and noisy edge.

Luo, S.Liu & H.Zhu [5] proposed an edge directed interpolation method based on canny detector. It modifies the NEDI algorithm from a statistical rules to predict the unknown pixels, combined with the classical covariance based interpolation algorithm.We deduced the EDI-BCD which could overcome the existing problem of NEDI in the edge regions and produces interpolated images with better objective qualities compared to that of the conventional interpolated method, especiallywhen it is applied to images with high –contrast gray level because of their evident features.S.Varadarajan *et al*.[9], proposed a distributed canny edge detection algorithm which can be mapped into multi core architectures for high throughput applications. The efficacy of this algorithm in detection psycho-visually important edges is validated using a visual sharpness metric. the algorithm achieves about 72 times speed up for a 16-core architecture without any change in performance. Furthermore, the internal memory requirements are significantly reduced especially for smaller block sizes.

II. Sobel Operator

The sobel operator performs a 2-D spatial gradient measurement on an image. It's used to find the approximate absolute gradient magnitude at each point in an input grayscale image. The sobel edge detector uses a pair of 3 x 3 convolution kernels mask. One estimate the gradient in x-direction (columns) and other for y-direction (rows).

A convolution mask is always smaller than the actual image.The mask is slid over the image, manipulating a square of pixels at a time.

The sobel mask are.[3][6]

-1	0	1
-2	0	2
-1	0	1

G_x mask

1	2	1
-2	0	2
-1	-2	-1

G_y mask

The magnitude of the gradient is calculated by using the formula below.

$$|G| = \sqrt{\left(G_x^2 + G_y^2\right)} \quad (1)$$

An approximate magnitude can be computed by the equation (2)

$$|G| = |G_x| + |G_y| \quad (2)$$

III. Canny Edge Detection Algorithm

The canny edge detector is widely used in computer vision to locate sharp intensity changes and to find object boundaries in an image. The detector classifies a pixel as an edge if the gradient magnitude is larger than those of pixels

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at both its sides in the direction of maximum intensity changes.It was developed by John F.canny in 1986 and which depending on the following steps[6][3].

1.Smooth the image by Gaussian filter to eliminate the noise in the image.

2.Find the edge strength for each point then find the edge direction by using

theta=invtan(Gy/Gx) (3)

3.Nonmaximum suppression is used to trace along the edge in the edge direction and suppress any pixel value(sets it equal to 0) which will give a thin line in the output image.

4.Finally, hysteresis is used to eliminate streaking which means breaking up of an edge contour caused by the operator output fluctuating above and below the threshold.

Hysteresis uses two threshold making an edge look like a dashed line.

IV. Proposed Algorithm

The proposed algorithm consist of three stages which depending on using hybrid edge detector(sobel and canny edge detectors) . in the first stage add salt & pepper noise to the image file then apply sobel detector on the image that contains a high frequency noises which signed these noise as a pixel of edge .

Also, if the input image file contains a weak edge ,sobel disable to detected. To filter these pixels, compute the canny edge detector. Figure 1 , shows the chart for the proposed hybrid algorithm.

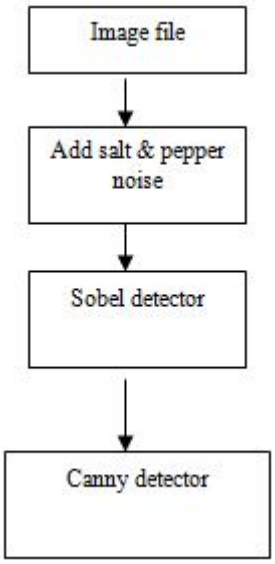

Fig. 1. Chart for combined sobel-canny edge detector

V. Results And Discussion

To evaluate the effectiveness of the sobel-canny hybrid algorithm, salt & pepper noisy images are tested. Figure 2, shows the results for sobel firstly, free image file on the upper left side, 3 x 3 mask for x-direction on the upper right side while in the second row, 3 x 3 Gy mask and after combined two masks the result in the right side.We deduce that, the sobel detector detect the edge in free noisy image well.While

Fig. 2. Results from sobel algorithm with free noisy image

in figure 3 , displays the original noisy image in the upper left side, the sobel operator in the right side .on the second row ,apply canny operator for the sobel result. With sigma =5.

Fig. 3. Sobel-canny detector for salt & pepper noisy image with sigma=5

From the figure above, notice that in sobel detector ,most of the pixels in edge are not detected because it's closely to the noisy pixel in the background. While in the third stage, it detects the edge of the(nine) number clearly and filtered most of noisy pixel in the background by Gaussian filter.

Fig. 4. Sobel-canny for free noisy image ,sigma equal to 5

Fig. 5. Canny-sobel edge detector for free noisy image with sigma =1

From figure 4 & 5, see that the canny detector is work better

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than sobel in free noisy image if the sigma is small.In figure 6(a), shows the salt & pepper noisy image file, sobel detector performing for a, the result in b. while in figure c, displays the result for performing canny detector after sobel with sigma 1.

Fig. 6(a). Original salt & pepper noisy image

Fig. 6(b). Sobel detector for noisy image

Fig. 6(c). Canny detector for the result of sobel edge detection

compare fig.3 with 6, see that the result of hybrid algorithm is better work if the sigma is increased.From the result, deduce that when apply sobel- in the second stage for the salt & pepper noisy image detect the nearest noisy point in the image file as the edge but when apply the canny detector in the third stage , remove these point as possible by Gaussian filter depending on the value of sigma.

Conclusion

Choice of the edge detection algorithm is very important steps in image processing . This choice is depending on the quality of the input image. The sobel detector is simple to design but it detects the closely noisy pixel in the image as an edge while the canny edge detector is the most rigorously defined operator and is widely used. The popularity of this method can be attributed to its optimality according to the best detection ,good localization and single response to an edge.In this paper, a new approach of hybrid algorithm which used sobel detector firstly then apply the canny operator in noisy background especially in the salt & pepper noise is described briefly .It tested with comparing a set of noisy free image and salt & pepper noisy image with different value of sigma

From the result, deduce that when apply sobel- in the second stage for the salt & pepper noisy image detect the nearest noisy point in the image file as an edge but when apply the canny detector in the third stage , remove these point as possible by Gaussian filter depending on the value of sigma Also, deduce that the combined algorithm is work in the best state if the sigma is increased.

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